California Environmental Protection Agency

Air Resources Board

PERMEATION RATES OF SCRIBNER PLASTICS
HIGH DENSITY POLYETHYLENE PORTABLE FUEL CONTAINERS

Engineering and Certification Branch
Monitoring and Laboratory Division

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High Density Polyethylene Portable Fuel Containers

Introduction

The California Air Resources Board (CARB) staff tested several Scribner Plastics High-Density Polyethylene (HDPE) portable fuel containers (containers) to determine average permeation rates. Scribner Plastics submitted six five-gallon portable fuel containers to the CARB staff for evaluation. Two containers were treated with fluorination, two with sulfonation and two were 0.25 inches thick walled untreated. Containers were preconditioned with commercial fuel, refilled with Phase II California Reformulated Certification (CERT) fuel, and subjected to a variable temperature profile. Permeation rates were then determined gravimetrically.

Test Protocol

Scribner Plastics submitted a total of 6 containers in August 2000. The six containers, in August, underwent the durability and preconditioning process, using commercial fuel, per CARB Test Method 513. All containers were stored at ambient temperature and pressure in flammable storage cabinets. After four weeks of ambient preconditioning, the containers were emptied; blown dry with compressed zero air, and immediately refilled with CERT fuel. The containers were then sealed using a hand held fusion welder and 1/4" thick HDPE coupons and leak tested as specified in Test Method 513 (a copy can be found at the CARB web site: http://www.arb.ca.gov/regact/spillcon/spillcon.htm).

After the first 5 days of testing, we realized that we inadvertently did not seal the secondary port of four containers. The secondary ports of the four containers designated as SCRIB-1, -2, -5, and -6 were then sealed with HDPE coupons and leak checked before starting the second 5 days of testing.

Weight loss was used to determine relative permeation rates. Sealed containers were weighed using a high capacity balance with a sensitivity of $\pm$ 0.1 grams. After each container was weighed and the weight recorded, they were placed in the Sealed Housing for Evaporative Determination (SHED) and exposed to a 1-day/24-hour/1440-minute variable temperature profile (see Attachment 1). This process is considered our diurnal cycle (recurring every day). Containers were then post weighed after each 24-hour diurnal cycle and the weight loss calculated.

Results

Cumulative weight losses were determined for each container as a function of time. The containers underwent a total of thirteen diurnal cycles, but results are

calculated using only ten cycles, each cycle is 24-hours. The first three days of test data were not used in determining individual per container permeation rates due to high variability. A summary of all test results can be found in Attachment 2.

The average permeation rate from the 5 gallon sulfonated containers designated SCRIB-1 and SCRIB-2 was determined to be 0.32 grams/gallon/day. This rate is based on data averaged from tests of two individual containers and represents a total of 20 individual 24-hour diurnal cycles.

The average permeation rate from the 5 gallon untreated containers designated SCRIB-3 and SCRIB-4 was determined to be 0.27 grams/gallon/day. This rate is based on data averaged from tests of two individual containers and represents a total of 20 individual 24-hour diurnal cycles.

The average permeation rate from the 5 gallon fluorinated containers designated SCRIB-5 and SCRIB-6 was determined to be 0.90 grams/gallon/day. This rate is based on data averaged from tests of two individual containers and represents a total of 20 individual 24-hour diurnal cycles.

Attachment 1

1 Day / 24 Hour / 1440 Minute Variable Temperature Profile

HOUR	MINUTE	ELAPSE TIME (MINUTES)	TEMPERATURE (°F)
0	0	1440	65.0
1	60	1380	66.6
2	120	1320	72.6
3	180	1260	80.3
4	240	1200	86.1
5	300	1140	90.6
6	360	1080	94.6
7	420	1020	98.1
8	480	960	101.2
9	540	900	103.4
10	600	840	104.9
11	660	780	105.0
12	720	720	104.2
13	780	660	101.1
14	840	600	95.3
15	900	540	88.8
16	960	480	84.4
17	1020	420	80.8
18	1080	360	77.8
19	1140	300	75.3
20	1200	240	72.0
21	1260	180	70.0
22	1320	120	68.2
23	1380	60	66.5
24	1440	0	65.0

Attachment 2

PERMEATION TEST RESULTS

October 2000

Diurnal Cycles* (# 24 hr cycles)	Container Identification	Container Mfg.	Container Volume	Treatment	Treatment Level	Test Dates	Fuel Type	Avg. Loss (g/gal/day)
10	SCRIB-1	Scribner Plastics	5 gallon	Sulfonation	-	10/16 - 10/30	CERT	0.60
10	SCRIB-2	Scribner Plastics	5 gallon	Sulfonation	-	10/16 - 10/30	CERT	0.04
							Average	**0.32**
10	SCRIB-3	Scribner Plastics	5 gallon	None (WT 1/4")	-	10/16 - 10/30	CERT	0.34
10	SCRIB-4	Scribner Plastics	5 gallon	None (WT 1/4")	-	10/16 - 10/30	CERT	0.21
							Average	**0.27**
10	SCRIB-5	Scribner Plastics	5 gallon	Fluorination	5	10/16 - 10/30	CERT	0.92
10	SCRIB-6	Scribner Plastics	5 gallon	Fluorination	5	10/16 - 10/30	CERT	0.89
							Average	**0.90**

*The results are based on 10 diurnal cycles, although 13 were performed. The first 3 days were not included because of high variability.